

**INTERVIEW WITH DR. CHARLES LUNDQUIST
INTERVIEWED BY STEPHEN P. WARING
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1. Waring: I'm talking to Chuck Lundquist. We're going to talk about Space Sciences in the 1970s. The first thing I'd like to start with is the contributions that Marshall made to Skylab research, both during the mission and in analyzing the data afterwards.

2. Lundquist: OK., I arrived in Huntsville in the middle of the Skylab operation, just at the end of the first Skylab mission. It was sort of an amusing start. I arrived on a Monday morning and had an entrance interview with Rocco Petrone, Marshall Director. That lasted until about 9:00 or so. As I was leaving that meeting, the person that had been acting director, Dr. Walter Hausserman, gave me a memo, or a fax, that had just arrived, assigning Marshall the responsibility for planning the Skylab operations to observe Comet Kohoutek. He said "I guess this is your problem now." Just by chance it turned out that the last thing I had done on Friday afternoon at the Smithsonian Astrophysical Observatory was a round of meetings on the observation that the observatory was planning to do using this ground based equipment and other things. The briefcase that I had with me had in it a goodly amount of information on the Comet. That was the last thing I did Friday afternoon. My last function at UAH, I mean at SAO, was to take care of some planning functions there. I just pulled out my briefcase that Monday morning. I knew the folks in the Space Science lab pretty well, having been there previously, so I had called a bunch of meetings and spent the rest of the day working on the Skylab plans for observing the Comet. Toward the end of the afternoon, it occurred to me

that I hadn't dropped by personnel office to check in and let them know I was on the job.

3. Waring: So it was a pretty smooth transition!

4. Lundquist: It was a pretty smooth transition! I was immediately up to my neck in Skylab which I had known I would be of course. I'd been following Skylab because the Harvard Smithsonian Complex had equipment on Skylab so I knew a good deal about Skylab already.

5. Waring: How would you summarize Marshall's contribution to the research?

6. Lundquist: Let me go on. For each of the major experiments that Marshall was associated with there was a person from the Space Sciences Lab assigned to be sort of the, I forgot the name they called it, but a alter-ego. It might have been "Experiment Scientist" or something but it was the alter ego for the PI so that the Principal Investigator may be off at some university and this person in the space science lab had the role of being his spokesman, his representative to do field work day by day following the activities. I had a team of such people. There had just been published I believe a report that described those people and their functions and all that was going on. I think I have a copy in my home library if you don't find that.

7. Waring: I don't think I've seen that.

8. Lundquist: It was a report that describes those kinds of operations in the laboratory. Kind of a who was doing who kind of report, who was doing what. That

would be a good one to look at. In addition to that, there were a few experiments where the PI was in fact in the Space Sciences Lab. One of the solar observatory, ATM experiments made the transition. The PI was in SSL when I got there. He later left and we brought in a new PI, Tannburg-Hansen actually. I forgot his name. He went to Goddard and that's why we hired Tannburg-Hansen to replace that. The experiments, to further answer your question, were divided into various categories. There was a whole group of solar experiments, solar observation capabilities. That turned out to be a very major success. In fact it for some years was the best source of solar information available in the world. It resulted in a whole series of monographs on the sun. You've probably seen the monographs.

9. Waring: Right.

10. Lundquist: One of the responsibilities of the Space Sciences Lab, I got involved in it somewhat - the Solar people took the main lead, was to arrange for the meetings and the procedures that generated those monographs, arranged for their publication and so forth.

11. Waring: would you say in a case like that the people in the Space Sciences labs were largely helping outside investigators assemble data, or was their role a lot more active?

12. Lundquist: It was more active as they were one of the PI participants so they had their own data, but other scientists had complementary data. For instance, one of the monographs, just to give you an example, was on coronal holes. The idea was to bring to bear on coronal holds the data and understanding generated by each of the instruments and intercompare and do synergistic analysis based on all the data.

So that it was the second step process, each observatory instrument first got its data analyzed and put in some workable format, and then the second generation of analysis was to look at common problems that could be addressed by data from all of the [?80].

13. Waring: To synthesize the information?

14. Lundquist: Right.

15. Waring: O.K.

16. Lundquist: And that was, coronal holes was an example and flares were another so that the way it was done, there were workshops sets up on these specific topics and the experts, both Skylab people and theoreticians and others that were appropriate met for, I think it was a week, may have been a little different in different cases, defined and argued and discussed what could be done, what understandings there were, what problems should be addressed, what analysis should be done to resolve the problems and then they all went off and did that work, it all got assigned. Then the group met again, for a week or so, heard the results of the analyses, and did further interaction and so forth, and began drafting a report which became the monograph, and then I think in most cases there was a third meeting to review the final result. There was one person designated usually to be the editor or compiler, or a team. It was a little different in different cases and different numbers of meetings. Look that up in the [? Prava Sevich Beach Monitor 95].

17. Waring: Yeah, I've seen the Skylab, you're talking about those big hard cover Skylab books?

18. Lundquist: No, no. These were standard sized books like this.

19. Waring: I haven't seen those. I've seen smaller ones, but I can ask Mike.

20. Lundquist: O.K. They became the, I have some, whether I have them here or home. They became the, well for some time, until they were superseded...

21. Waring: These were what I was thinking of.

22. Lundquist: No, those were popular. These were hard-science monographs. No, it's a standard, this kind of size. They became the, probably still [are] the book on coronal holes. One title I remember, OK, I got a little more involved in that one for some other reasons, surprised I don't have it here. I guess it must be in my library.

23. Waring: well that's ok, I can check through Mike.

24. Lundquist: Oh, here, here's one of them, [? title 112]. There are a whole set of those.

25. Waring: And these workshops, would there be a member from the, a scientist from the Space Sciences Lab usually chairing them or would the chair rotate, would there be primarily an outside chair, or would there be a chair at all?

26. Lundquist: well I think we contracted with the High Altitude Observatory of Boulder to be the logistic arm, we just, a lot of logistics involved, and we had to I think in all cases that was the case, but again by looking at, See this is the Workshop Number III. Solar, I think Coronal Holes was the first. See and this was edited by Frank Orral, Colorado University Press, so we contracted with the University of Colorado, they were very major participants, and so it was a good choice to make to give them the role of doing the logistics on all this, and they were very pleased to do that.

27. Waring: O.K., I'll check with Annette. I've got, can I borrow this, I'll get it back to you?

28. Lundquist: Yes, sure.

29. Waring: I suspect they probably have that at the Technical Library at Marshall. If I have the title for one, I can find the others.

30. Lundquist: Yes they would have all of them. I think there were maybe, This is Number III, there may have been four. They didn't all come out at once, but they overlapped somewhat.

31. Waring: Would there have been something like this done on or for Material processing experiments?

32. Lundquist: Yes, let me get to that. The solar stuff was such a major advance in solar science, and it's to the credit of Skylab NASA headquarters people. They insisted that after the flight was over, that there be a continuing flow of significant

money to analyze the data. So this was, I remember, a multi-million dollar kind of operation getting these analyses and the books done. But they became while they were current, which was for several years, maybe a decade, the standard books on solar science, a very major kind of thing. We managed it out of the Space Sciences Lab, a continuing, it was a remnant of the Skylab project office. It was involved too, they were mainly addressing it in these books.

33. Waring: The popular variety version?

34. Lundquist: Yeah, and we took main responsibility for this, but I guess the money may have flowed through that office that we took responsibility. This was one of the very major results, this set of books. I'm very, I'm surely prejudiced, but my belief was they were very well accepted, and was looked at as a substantial advance. If you had this set, you had the latest on solar science. So, so much for the solar.

When the Comet stuff of course was done more early, made use of some of the same observing equipment, because for instance, there were observations of the comet right up to the sun by the coronagraph. Having the coronagraph in orbit allowed observations of the comet very close to the sun, as it got into the, where the, far beyond where you could do anything from the ground. Others of the stellar instruments could observe the comet. And then there were [was] new equipment brought up. We rushed to get ready for Skylab Mission 3, it was over the Holidays in '73 and into '74, which was when the comet went by the sun, was in that period, so most of the observing from Skylab of Comet Kohoutec was done during the third Skylab Mission and some new equipment was set up. I have the literature on that. There was a conference held at Marshall on, yeah, here it is have you seen that? That gives, that's a summary piece. lots of results were published separately.

35. Waring: Can I borrow this too?

36. Lundquist: Yes, sure.

37. Waring: Put your name in that. (laughter) I've got so many books, you would not believe it. But I'll get these back to you probably within the week.

38. Lundquist: So this was a workshop held in '74. A lot of the literature was just in standard journals and reports, also. This gives a summary of what all happened with the Comet. What different observations were made, what the results were. While the Comet didn't get quite as active as some of the early predictions would have made it, it was still the best observed comet ever observed. So again, it was a fairly major step forward, while on the popular side, it wasn't the spectacular view that some people had thought it might be when it was discovered so early. But on the other hand, the observations made by Skylab and by other ground-based things, certainly there was a coordinated ground-base observation program that went with this. There were solar-based observations, too. I should have mentioned it there. Part of the responsibility that we had was scheduling times when ground-based observatories would observe the sun or the comet at the same time in coordination with the observation from Skylab. So one could make a link between ground observation and space observations, and so forth. There was in both cases a network of coordinated observations on the ground and in space. Again, probably at first there hadn't been a lot of that done previously, and it helped straighten out discrepancies between ground and space observations in a very useful way.

39. Waring: Did NASA do any special training for the astronauts on the third mission for the comet observations?

40. Lundquist: Yeah, some.

41. Waring: Do you remember what was involved?

42. Lundquist: Oh,

43. Waring: Obviously they wouldn't have known how to use the instruments...

44. Lundquist: No. Let me back off and say by the third mission, I had a whole team of people in Houston. I'd moved a whole bunch of them. . .

45. Waring: Yeah, Tony DeLoach told me about it, he was one of those.

46. Lundquist: He was one of them, but there was a bunch of others. And actually moved the assistant director of the lab down to Houston, Ray Hembree, the assistant lab director was in residence down there to handle all the administrative things that went with having twenty or thirty people down there. I don't remember the numbers, look it up, but it was a substantial number of people spread out across all kinds of disciplines, and so we just needed to have a senior management presence in Houston to help run things.

47. Waring: How do you spell his last name?

48. Lundquist: HEMBREE. He's still in town if you want to talk to him. He's retired I think. He was working for [Othogene Associate 217], but he may be working somewhere else now. Anyway, he was down there and I flew down frequently, and we had a split operation. We had people in Huntsville very busily working on aspects of Skylab, and we had a whole team of people from the lab down in Houston.

49. Waring: Did the, were the people involved in the operations?

50. Lundquist: Oh, yeah, sure!

51. Waring: Were the people involved in the operations here in Huntsville, were they working primarily from the Huntsville Operations Control Center?

52. Lundquist: There was not really a Huntsville operations support system at that time, to speak of.

53. Waring: This was primarily from the lab itself [? 224]?

54. Lundquist: Primarily, right. And the main operation was out of Houston, where there science desks and we had people manning various desks and so forth.

Then the Materials ends of things, of course, there were quite a few specialized pieces of apparatus for Materials investigations and UAH for instance was involved in a couple of major ones, various universities were involved one way or another. The analysis of those data weren't as focused as the solar data. It was a much less mature field. Solar astronomy was at that time a very mature field, whereas Materials experiments in space was very exploratory and rudimentary, and

there wasn't the depth of knowledge to make the procedure that we used on solar astronomy work as well. Results were still too early and too isolated. You know, you had an isolated result without a lot of things around it to make synergistic analysis. But there were some results workshops. I don't think I have any of the, well there were some things of course described in the final mission report.

55. Waring: Right, I've looked at that.

56. Lundquist: Which goes beyond just Skylab. And that's another factor to mention is that the Materials stuff rather quickly made a transition into experiments on ASTP, whereas there wasn't a solar observatory on the Apollo/Soyuz thing, so while the solar people were off analyzing and capitalizing and synergizing, the Materials folks moved on to a next generation of experiments on Apollo/Soyuz, which was a less-developed field. So that's why Bob's book goes not only through Skylab but also through ASTP.

57. Waring: Right. I've interviewed him. He was very helpful about this.

58. Lundquist: Yeah. Let's see. There's other stellar observations too. Or other astronomical observations, things like zodiacal light, and so forth. There were a team of people involved in that and the instruments there. Then finally there was the whole earth observations, and that was handled mostly by the Johnson Center, and the life Science Observations handled most of the electronics and so forth. So although we had some interest in those, they weren't our prime responsibility.

59. Waring: How long do you think, you mentioned the headquarters continued funding the study of Skylab results. How long do you think that worked, continued in a major way?

60. Lundquist: Several years. Let's see when this book was published. The date of this is '81.

61. Waring: So giving this was 18 months or so, maybe through '78 or '79, there were still lots of activities going on.

62. Lundquist: Yeah, it went on for several years. It tailed off eventually, I guess I don't remember the exact funding profile, but it went on for years.

63. Waring: Is there anything else you can think of about Skylab research?

64. Lundquist: One of the things that happened to Skylab doesn't seem to have happened on the Shuttle, the [?Aptwert lieist 285] well we talk about it, but I'm not quite sure how to say it clearly. By the time they got to Skylab 3 mission, getting things done and getting things sent up, and getting the astronauts to do various experiments and innovative things, it kind of became pretty easy. There were a bunch of demonstration experiments. I guess I didn't talk about that, but the astronauts had extra time so there were a whole bunch of demonstrations of one kind or another, they were called, don't want to call them minor experiments, they were less demanding experiments or experiments of opportunity. Some of them, very penetrating experiments that were done, were done sort of during the last, during the operation in real time, and they could be accommodated with the safety documentation and all that got done. That ability to do things with minimum

documentation and do it late, hasn't continued in the way we really expected it would. We thought it would get simpler and simpler to fly things on manned operations and in fact after the Challenger accident, it's gotten harder and harder to fly things. So there was a feeling by the time Skylab was over, there was a feeling of euphoria that was really very. . .

65. Waring: You'd broken into a new level of . . .

66. Lundquist: A new level of capability.

67. Waring: Why do you think that was? Because it was one piece of hardware and the missions were so long?

68. Lundquist: well the length of the missions helped, and then we tried as we started planning for the shuttle to do, to use a simple approach, and for one reason or another, the use of the shuttle became very organized and very formalized.

69. Waring: Bob Nauwmann told me something similar. He thought a lot of it was safety . . .

70. Lundquist: Yeah. . .

71. Waring: . . .concerns.

72. Lundquist: Safety concerns have been the banner, some of it's just been bureaucracy.

73. Waring: You can justify anything with safety concerns.

74. Lundquist: Right. Yeah.

75. Waring: So can you give me an example of a demonstration mission that was, a demonstration experiment that was developed, sort of in real time?

76. Lundquist: Oh, there was a whole bunch of them, [I] imagine a whole book on them, I don't have a copy it here. [Pause] Probably listed in this book. This is the overall name of a chapter of [? 336],

77. Waring: I can check. I'll go out and . . .

78. Lundquist: See there was a whole volume. . .

79. Waring: [?339] and Mike together. Was it a glossy one like this?

80. Lundquist: Yes.

81. Waring: OK.

82. Lundquist: I believe so. I thought maybe they had a table of all the experiments in this one. Let's see what other references I have. Most of us have [351]

83. Waring: That's hardware. I've looked at that.

84. Lundquist: We had a student, here they are.

85. Waring: They are in, a, I've got a copy of that.

86. Lundquist: OK.

87. Waring: That's the a, the mission, the final mission report.

88. Lundquist: Yeah, I didn't mention the student experiments, but that was another big activity. When you added up all these different things, it was a pretty major scientific endeavor. This is probably as good of list of experiments of the different kinds, and there are individual volumes on each set.

89. Waring: Right. Very good. If I remember that one correctly, it had a bibliography at the end.

90. Lundquist: Well, some references, yeah.

91. Waring: That would have a lot of the kind of early '74, but that will help me.

92. Lundquist: Well there was, I think, a volume like this one. Or if not, some of them may have got included, I know I included some and Bob did too, in what were pertinent to a particular discipline, so they may have gotten covered a couple of places.

93. Waring: All right, I'll check.

94. Lundquist: Maybe I'm misrecalling, there was one on the student experiments, and maybe I'm confusing the volume on the student experiments with the volume of the demos. These years, the memory fails on such . .

95. Waring: Well you get into lots of sophisticated and detailed information when you get into this sort of research. We just need to show that Marshall was involved in a lot of that and it was very successful

96. Lundquist: Particularly from the solar point of view, probably was one of the most successful things until the times of the Solar Max satellite or something like that, and then it started to supersede some of the Skylab results. Things like Coronal holes it probably, I guess, it superseded.

97. Waring: OK. Well lets shift gears a little bit and talk about Marshall's diversification in the '70s. Beginning in the late '60s and early 1970's, Marshall began to diversify. They grew to largely being a propulsion center to getting involved in all sorts of work. And one thing Marshall got involved in was the scientific payloads, and in helping to, helping with the operations of scientific missions, or science missions. Could you talk generally about the role of the Space Sciences Lab during that diversification? was there a concerted effort from above to get people in the Space Sciences Lab to be sort of entrepreneurs who were going out and getting smaller science projects?

98. Lundquist: Well there was a group within the Program Development office that had the primary responsibility for looking for new jobs for Marshall, including science missions. And that group, maybe Herman Gierow was the head of it at the time, that group worked closely with Space Sciences Lab. In fact, many of the

people in that office had been transferred out of Space Sciences Lab earlier to create the office. So there was a good working relationship between the program development team who had the responsibility for seeking new missions and the folks in Space Sciences Lab who supported a lot of that. It was a joint effort between the Program Development Office and the Space Sciences Lab.

99. Waring: Would you say. . . at one point in an earlier chapter, Andy had written the passage saying that Program Development was mainly responsible for developing these new projects, and then one of the comments we got back on this chapter, I believe it was from Bob Marshall, he said that most of these new projects came from the labs, and then quickly went to Program Development.

100. Lundquist: Yeah, there was a certain amount of that. The scientists in the lab were more attuned to what things needed to be done, and . .

101. Waring: . . .had the connections with the people in academic] disciplines.

102. Lundquist: Right, to identify opportunities for missions, and then they'd work with their friends in Program Development to promote a mission. That's, I think both are true. It was a cooperative thing with many of the ideas coming out of the lab, as we discussed.

103. Waring: Right. While you were head of Space Sciences labs, did Marshall try to get an Operations Room? was there a concerted effort to get an Operations Room, say, for Space lab?

104. Lundquist: well, as we began planning for the Shuttle mission, or Shuttle missions, and particularly the Space lab missions, one of the things that the lab agreed to do was provide the mission scientists for the various missions. It was my job to nominate people, so I for instance, Rich Chappel was nominated for Spacelab 1, and Gene Irvin for Spacelab 2, George Fichtl for Spacelab 3, and in fact we had people for even some of the earlier, non-space lab missions for handling the science interfaces on some of the earlier missions. In order to, well let me be careful how I remember this right. Marshall of course for its Vehicle Operations had a data center and an analysis center.

105. Waring: Yeah, the HOSC.

106. Lundquist: The HOSC, right. So it was natural as the center got involved in the science part of the shuttle missions, to look at some kind of extension of the HOSC to include science data, science operations, as well as the Vehicle performance operations. So it sort of grew in a natural way, thoughts of doing more in Huntsville, grew in a natural way out of that existing capability.

107. Waring: There wasn't a time when there was just a decision made that Marshall needed this sort of operation? what do you call that room, the po. . .

108. Lundquist: The POCC. Oh there might have been a time when one of the directors decided to make a major presentation or effort in Headquarters, and it bubbled up in an evolutionary way, and there may have been some interface with one of the That could have even been after I left Marshall.

109. Waring: Right so it could have been, it could have happened in the 80's?

110. Lundquist: Right.

111. Waring: But you would say largely that the creation of the POCC was almost a labeling, a new label for something that had been gradually evolving with the new shuttle flights.

112. Lundquist: Yeah.

113. Waring: I need to check into that further.

114. Lundquist: I guess it started out as just a capability to monitor what was going on.

115. Waring: Right, right.

116. Lundquist: Almost a C-Span kind of operation, and in fact we had something of that kind, I guess, even during Skylab, I believe. I'm a little confused as to how extensive it was. I was in and out of Houston so much I didn't use them. But there was always good . . . [508] . . . there was some support operations in Huntsville during Skylab 2, and we were, all engineering teams to use them.

117. Waring: They controlled the thermal systems, and some other vehicle attitude out of the HOSC?

118. Lundquist: Yeah. It just sort of evolved and grew. It may well have been a time zone one of the director's made an overt effort to get a better statement or a more inclusive statement.

119. Waring: Do you recall any resistance to that on the part of Houston or Goddard, or were they both so busy that they didn't see any?

120. Lundquist: Oh, no there was always a role in mission squabble over who did what in the way of ground-operations. For instance, there's always been sensitivity about who could talk to astronauts and things of that kind [laughter]. I guess the scientific world never got to worked up about it. Oh, you know, some people might have, but by and large things got done. But there was always a little bit of, wouldn't quite call it friction, a little bit of maneuvering or posturing over where the interfaces were between what the different centers did.

121. Waring: Can you remember any specific examples of that sort of thing?

122. Lundquist: No, not . . .

123. Waring: It seems that a lot of that squabbling went on at the center director level or very high management level, and they were largely concerned about if they gave up their turf, they'd lose money.

124. Lundquist: They'd lose money and personnel lines.

125. Waring: And personnel, right.

126. Lundquist: See during some of that period was the time of the RIFs and so forth, so missions were important to a center because if you lost one, you lost people and you had to go through a reduction in force. So it was a substantial issue for the management.

127. Waring: Right. But people at the working level, people who were involved in just operations of specific experiments were not interested.

128. Lundquist: Oh, I wouldn't say they weren't interested. They were probably interested, but in fact it didn't affect them too awfully much.

129. Waring: OK.

130. Lundquist: They were all interested in seeing their center do well and keep people, but they weren't, well, front line troops on the battle.

131. Waring: That's right. It wasn't their decision anyway.

132. Lundquist: Yeah, it wasn't their fight anyway [laughter], Sort of watch it and understand it and be cheering on the sidelines, but they weren't in the thick of the battle.

133. Waring: let's turn from diversification and operations to talking about commercialization. It seems that in the late 1970's NASA sought to make it's work more commercially useful?

134. Lundquist: let me check with my schedules. I may have a 10:00.

135. Waring: Now you read an isolated piece of correspondence here and there, and you think, ha, there's some stuff going on, but without interviews, you can't put it together. So anyway there seems to be throughout NASA an effort to commercialize scientific research, and at Marshall, this seemed to have been important in Materials Processing in Space, an effort to try to get some corporate sponsorship and corporate interest and in solar energy and coal mining. So a lot of this seems to have begun in the Carter years and really took off in the Reagan years. Could you comment on that? why do you think during this period there was more of an interest in commercialization? Did this affect the Space Science lab much? Did it affect your work much?

136. Lundquist: Well a little, but most of the real thrust of that came after I left, but a lot of it was just sort of inevitable. As civilization moves into new frontiers, commercial interests aren't very far behind. I remember prior even to the launch of Explorer I being involved in discussions about communications satellite options. That option was recognized very early, so that by the time you get into the period you're asking about of the 70s, communications satellites were already a

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development dimension of space, it was already there in a multi-billion dollar communication industry. The question was rather what would be the next one, how would it go, what would be the role of government. So there was an awareness that it was going to happen inevitably, it was already happening, so the thing we were concerned about was understanding how it was going to evolve, what should NASA's role be in it, particularly the next one that appeared likely would be commercial, was the earth observation side of this.

137. Waring: For agriculture, environment,

138. Lundquist: All these kind of things. So there were studies of that, and part of the Skylab earth observation activity had some of that dimension, doing, say, development, a piece of how do you do agriculture assessment, so this needed to be demonstrated and developed with some thought that eventually that would be a commercial enterprise at some link. So from the very beginning of the space era there had been recognition there was going to be this commercial dimension to it, and the entire issue has been one of sort of policy, what was the right policy of the federal government and NASA with regard to commercial involvement in space. That went through all kinds of ups and downs. The thing came to a head, I guess, back in the mid-to-early 80's, during the Reagan administration when, I'm getting ahead of the story quite a bit, there was a commission appointed, headed by Bud Evans, to do a national policy study of the commercial development of space, and that study was reported, it involved both the white House and NASA headquarters, and that was reported, led to the legislation that created, the revised legislation for NASA. It was a major revision of NASA authorization bill or charter in what, about '84 I guess, thereabouts, and that led then to the creation of the Office of Commercial Programs and so forth. Now Bill Snoddy would be a very key person to talk to because he was on that committee, so he was assigned out of Marshall to be on Bud Evans working group. So Bill spent a lot of time with Headquarters in the middle of all that.

139. Waring: OK. Well that's very interesting, I didn't know about that period in the 80s. I'll have to go out and talk with people in Marshall's Commercial Applications office too about some of this.

140. Lundquist: I maybe should show you an archive we have here. As you know, we had Stephanie Gilmore working for us for a while, I guess we're about to replace her, providing an archive for the consortium. One of the things in the archive are a lot of these documents that lead to the creation of the Office of Commercial Programs, the CCDS's and so forth. We can give you access to that. I've got it collected together in a fairly organized way and indexed way, so,

141. Waring: OK, I'd like to look at that.

142. Lundquist: You're surely welcome to use that if you want to.

143. Waring: OK.

144. Lundquist: I've got copies of a bunch of the documents that describe this rethinking of the NASA policy or the national policy with respect to commercial involvement as it was reexamined in the middle 80s.

145. Waring: Would you say a lot of the initiative for this sort of thing came directly from the white House or was this pressure from the Aerospace industry, or both together?

146. Lundquist: Well it was different by field, I guess. Communication Satellite people were faced with an issues of whether the U.S. as a nation would continue to help with R & D in Communication Satellites. For a while, probably under the Carter administration, maybe preceding Carter and going back to Nixon and Ford, there was a decision that the U.S. communication's satellite industry was robust

enough it could take care of its own R & D. And there was at least some perception that the U.S. was losing its grip on the Communications Satellite industry because the governments of other competing nations were helping their industries with new technique, R & D, and the U.S. had declined to do so.

147. Waring: Right.

148. Lundquist: So in fact, there was then a reverse decision made that the U.S. had better give NASA some role in continuing R & D in Communication Satellites to keep the cutting edge sharp or else the U.S. would lose out. It wasn't easy for U.S. communication satellite industries to compete, not only with the Japanese and European industries, but the government of Japan and the governments of Europe, so the playing fields had to be leveled a little, and so in the Communication Satellite industry, there was a constant argument, reconsideration over the proper role of NASA and of the government. Marshall had a piece of that. For instance for a while they were, maybe still are, looking at the option of putting a very large platform in geosynchronous orbit to house a whole bunch of instruments of various kinds. You might say almost a geosynchronous space station.

149. Waring: But of communications instruments, and scientific instruments?

150. Lundquist: Yeah, and so forth, but in geosynchronism. That hasn't materialized, but I suppose eventually it will. So that's the communication, it's been up and down.

151. Waring: Right.

152. Lundquist: The earth observation stuff has been a fiasco. Again, Marshall hasn't, well they've had some role in it, but not the same level that say Goddard or Houston had.

153. Waring: This is like the Mission to Planet Earth?

154. Lundquist: No, [707] about commercialization.

155. Waring: Commercialization.

156. Lundquist: The mission to planet earth, I'm still trying to address your commercialization issue.

157. Waring: OK

158. Lundquist: Mission to planet earth was largely a scientific thing.

159. Waring: Oh, ok. All Right.

160. Lundquist: But let's say the thing that [? Spotty Mahg 709] and France is doing so very well. The French pretty much captured the earth observation commercial role. The company, SpottyMahg is going great guns. The U.S. couldn't get its policy straight, how it wanted to do it. When I taught a course in Commercial Development of Space over in the Business School, it just happened that some of those things were being argued at the time, so all during the term, every now and then, we'd get the day's newspaper and talk about the policy arguments that were going on between Congress and the Administration over how to arrange the

commercialization or to enable the commercialization of earth observations in the U.S. They are still going on, there's still a raging argument in space daily, in space [? 719] about the role of the Department of Interior, Congress, and the EOSat Corporation, and the government commitment to it and the government backing out of it. Its been just a decade of bad U.S. policy making. We couldn't decide what to do as a nation. So meanwhile the Japanese, I mean the French, pretty much captured the field. They're making a good business out of it. So that was the next one. Sort of the one exception, though, in that area where the U.S. has done very well is Intergraph, and that's in the value-added operation on the ground. While Intergraph doesn't talk much about it, they are clearly one of the biggest value-added operations of that kind in the world. They do all kinds of things for all kinds of people, most of it in a proprietary way, so there's nothing said about it.

161. Waring: What do you mean by that?

162. Lundquist: Oh, somebody wants to work an oilfield off South America, say. So they want to analyze a bunch of . . .

163. Waring: . . . satellite images?

164. Lundquist: Satellite images, and other data. They get Intergraph to do all that analysis for them, but they don't tell anyone about it until they get their oilwells drilled, they don't want other people to know of the prospect.

165. Waring: Well that's interesting.

166. Lundquist: So, a lot of that goes on, a lot of it goes on here in Huntsville that isn't well recognized. That's one of the reasons Intergraph is as big as it is, it does an awful lot of that kind of stuff for a lot of people on the Q.T.

167. Waring: Right.

168. Lundquist: Going on, Materials, Marshall took the lead on that. It's been hard because it required so much access to space. It didn't lend itself to putting up a satellite that would last for years the way communications and earth observations did. So its been harder going, less mature.

169. Waring: OK. Well that's very helpful, it gives me a big perspective. Two of the more unusual things that the center was involved in the late 70s were solar energy, ground-based solar energy, and coal-mining. Does Space Sciences Lab have a role in those?

170. Lundquist: A minor, minor role, yeah.

171. Waring: Those were likely through the other engineering labs.

172. Lundquist: Yeah, yeah.

173. Waring: OK. lets pass on from this to some more important issues. Could you give me some names of some people to, I'm going to turn this off. [machine turned off, 762]